# Assessment of Group Projects Beyond Cooperative Group Effort

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**ABSTRACT.** This work investigated whether learning from group projects can be enhanced by innovative methods to get students involved in individual efforts to understand the group reports of the whole class beyond the typical dead-end submission of group reports to the instructor. The groups first worked together and submitted a group report. All group reports were then placed on the course Web site. Individual students, working alone, then submitted a report providing a critique of reports from other groups. An anonymous assessment survey found that 66% of the students felt that this combination of group and individual effort was more effective than group work alone for an in-depth understanding of the assigned task. A more direct measure of in-depth under-

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standing following group and individual efforts using two quizzes supports this observation. 

**KEYWORDS.** Group projects, pharmaceutics, educational research, peer evaluation

## *INTRODUCTION*

Group activities and other active learning exercises increase student interest in the subject matter being taught and lead to students taking greater responsibility for learning. A peer grade, where the students evaluate themselves and their group, is often a part of the process and contributes toward the grade (1, 2). A major problem with many innovative teaching methods involving group projects is the evaluation of individual performance and contribution (3). In general, students do not like the idea of self- and peer review and are reluctant to spend time on this process and to give constructive criticism to their peers. Some students complain that their particular group is not effective because of personality differences and willingness of specific individuals to participate in this activity. The peer- and self-review process has been stated to be the most frustrating aspect of group projects by the students. The students are afraid of hurting each other's feelings (or more importantly, the grade) (4). It has also been suggested that use of traditional peer evaluations may be negatively associated with best group experiences. When poor group dynamics occur, the students may tolerate the conflict so that they can provide poor peer evaluations to those responsible rather than try to resolve unproductive conflicts (5).

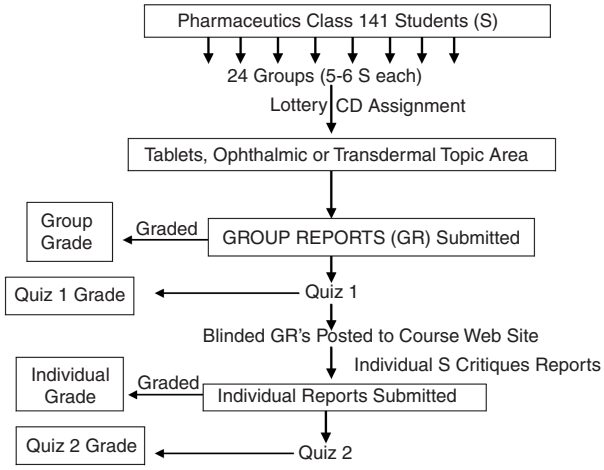
Group activities are important, however, as these activities involve cooperative learning, where students work together as a team to maximize their own and each other's learning (6). This project sought to address the problem related to accountability of individual effort by developing a means for the group projects to be assessed at a second level by individual students after the instructor has evaluated the cooperative group effort. It was expected that this two-step process would be of great benefit to the students because they were exposed to all projects assigned to the class. Any one group project is limited in its scope, but taken together, all projects cover the basics of the project thoroughly. Another expected outcome of this activity will be a greater under-

standing of assigned topic/task beyond the typical dead-end submission of group reports to the instructor. Although many instructors discuss the reports in class and/or include the material on examinations, it is thought that the activities carried out in this project are likely to be more beneficial for a greater understanding of the material covered in the course. Revisiting their group work in relation to what others have done could also lead to a greater retention of the concepts on a long-term basis. Also, this method could make the cooperative group activities more acceptable to the average student and might lead to wider acceptance of this method of teaching in pharmacy schools in other universities. This may be a potential solution to many problems related to assessment of individual effort in group projects as described in the literature addressed above.

## *METHODOLOGY*

A pharmaceutics class consisting of 141 students was divided into 24 groups, each having 5 or 6 students (Figure 1). The instructor chose the groups. Each group was given one CD which had the assignment along with some graphics for a better understanding of the dosage form. Each group received a project involving one of three dosage forms (tablets, ophthalmics, and transdermals) to work on. These three topics were covered in class before the group projects started. Each of the three dosage forms was assigned to eight groups by a lottery drawn by the group representative in class. A common class of drugs, beta blockers, was used in each dosage form, with the projects involving designing a sustained release tablet dosage form for sotalol, a transdermal delivery system for propranolol, or an ophthalmic drug delivery system for metoprolol. The group projects were divided into two distinct steps, and each step was assessed separately. In the first step, the group worked together to design the specific dosage form assigned to it. The groups were asked to state if there was a rationale for such a dosage form and then proceed with the design with a scientific approach listing any assumptions made. The groups were asked to consider drug dose, solubility, molecular weight, salt form, dissociation constant, etc., in their rationale and to list the active and inactive ingredients in the formula (along with quantities). The groups were encouraged to be creative in their design and were told that their approach, research, planning, logic, and thought were important and that there was no predetermined standard correct response. The groups were also asked to provide patient counseling instructions for their dosage form, taking into consideration any special instructions relating to the drug. All group reports were submitted to the instructor as e-mail attachments. A quiz was given to assess students' understanding of the

FIGURE 1




three assigned dosage forms, and then all group reports were posted on the course Web site.

In the second step, the work done by the groups formed the basis for individual learning and assessment. Individual students, working alone, were asked to submit a report that would include a critique of group reports, including any errors or oversights in patient counseling for appropriate use of dosage forms. All group reports were posted on the course Web site after removing identifiers so that the report could not be linked to any specific group. Students were asked to choose at least one report from each dosage form (tablet, ocular, or transdermal) but encouraged to critique several or all group reports. The students were told not to critique their own group's report, but they still had to critique a different group's report on the dosage form assigned to their group. All groups received a grade for their collective effort (report) prior to this activity, so the critique did not affect any group's grade. The idea was to encourage the students to be critical of the reports without the fear that it would adversely affect the grades of their fellow classmates. Students were asked to be specific in their individual critiques. The thorough critique the students provided in turn helped the instructor to evaluate how carefully the students have read the reports from the other groups. Students took a second quiz on the same three assigned topics after submitting their critiques to the instructor.

For Step 1 (group report) of the project, the students in the group received a group grade that reflected the collective effort of the group. This was worth

4% of the course grade, while Step 2 (individual effort) was worth another 4% of the course grade. Peer evaluation was not a part of the overall group project grade. The lack of peer evaluation did increase the risk that some students would not contribute to the process, but observation and feedback from groups indicated that almost all students did participate actively, as they needed to learn the material to provide the individual critiques (Step 2) and to take the final examination. A mechanism was provided to deal with any students who may not have fully participated in the group activities. For any such students, the groups were empowered to expel these nonparticipating students by a unanimous vote of the other group members. Any expelled students were then to be handled by the instructor. However, no students were expelled during the course of this project. For Step 2, the individual students submitted a report and were graded on an individual basis as explained in the next section.

## *STUDENT REPORTS*

The student groups spent considerable time on the project, and the reports they submitted were generally of high quality as assessed by the instructor. In reports on tablet dosage form, the student groups considered the half-life of the drug in their rationale to make a sustained release dosage form. The groups identified specific excipients such as lubricants, glidants, disintegrants, and diluents. Varied approaches to provide sustained release, including coating, wax matrix, multilayered tablet, osmotic technology, and a combination of approaches were proposed. Where appropriate (depending on the methodology chosen), the groups correctly identified whether the tablet should not be chewed or broken and listed this under patient counseling instructions. Deficiencies, such as lack of release rate specifications, and other feedback were e-mailed to the groups by the instructor. Based on some of the reports, the instructor also later provided some information in class on how patented technology can or cannot be used by another manufacturer.

The groups that reported on ophthalmics were also evaluated on their isotonicity calculations and sterility considerations. Possible problems such as adsorption of the preservative benzalkonium chloride on soft lenses or its incompatibility with anionic drugs were pointed out. In some cases, the instructor realized from the reports that the students did not have a clear understanding of some aspects of sterile processing, such as molecular size in relation to sterile filtration, and these concepts were then discussed again in class. Packaging and patient counseling instructions for each dosage form were also critically evaluated to see if the students took into consideration the

pharmacokinetics of the drug and the specific dosage form design considerations.

For the transdermal reports, the proposed patch design was critically evaluated to see if the students understood the concepts (e.g., the amount of total drug that would be in the patch as compared to the amount that would be delivered over a period of time, and other considerations such as loading dose). The dissociation constant of the drug and its implications for flux through the skin were addressed by some groups, especially if they designed an active energy patch, such as one being driven by a small current. The reports were checked to see whether the students considered the lack of first-pass effect and flux rates when converting oral doses to transdermal doses.

The groups came up with fancy brand names for their products. The instructor graded all 24 reports, and the grade and appropriate feedback were provided to the groups. Prior to start of the project, the students were told that the assignments were fairly open ended with no firm right or wrong approaches. The students were told to be creative in their reports as long as they elaborated on their answers in a short and succinct manner. Thus, student groups who used a well thought out creative approach to their dosage form design received high grades. For example, a report on tablet dosage form that was scored high provided a rationale to make a sustained release dosage form and listed all excipients proposed to be used with pharmacopoeial status and quantities. This suggested to the instructor that the group had a logical understanding of the concepts. Furthermore, the report provided target release rates for the controlled release dosage form. Patient counseling instructions specific to the design process were provided. A report on tablet dosage form that was scored low did not consider the half life of the drug or other factors to justify the need for sustained release dosage form but designed such a form anyway. Discussions in the report relating to granulation and drug hydrophilicity made it clear that the group did not have an understanding of the concepts involved in tablet manufacturing. The weight of the excipients proposed added up to an unrealistic total tablet weight, and a general textbook description was provided in some places where it was not relevant or required.

Once all the group reports were posted on the course Web site, students read the reports from other groups and then submitted a critique that represented their individual effort. The instructor then evaluated this critique submitted by each of the 141 students. A scientific critique listing specific points was given higher points by the instructor than a more general critique making broad statements. For example, one student pointed out that a group had used sodium chloride to design an osmotic pump for an antihypertensive drug in a way that will release sodium to the body. This should not be done because hypertensive patients must limit their salt intake. Some students pointed out that

many group reports inappropriately designed a sustained release dosage form in cases where it was not needed (e.g., where the drug half-life was very high). Some calculation mistakes and lack of students' understanding of the FDA's role and authority were also pointed out. Possible problems relating to patient compliance that may occur with complicated designs proposed by the students were identified. Errors in formulation proposed (e.g., the need for a disintegrating agent in a sustained release tablet) were corrected. The need for proper skin contact for the patch to ensure consistent flux was pointed out. Similarly, unrealistic tablet weights and other problems were pointed out. The instructor then discussed these critiques in class, including both the deficiencies and the good points.

## *EVALUATIVE DATA*

The effectiveness of this project as a learning tool was evaluated by using an assessment survey (Appendix). The survey was distributed in class following the completion of the project. This survey was anonymous, so students could answer without any need to identify themselves. The students were asked about the utility of group projects in general, and 91% of the students said that group projects are useful to enhance learning in addition to didactic lectures. The students were also asked if the methods used in this project were useful as compared to other, more traditional methods, such as group projects alone (with peer evaluation). About 66% of the class said that the format used for this project (separate assessments for group and individual efforts) is a better format for group activities than group efforts alone that include a peer assessment component. The students had been exposed to a group effort with peer evaluation in a different course in the semester immediately preceding this course. About 19% thought that group projects alone were better, and 15% thought that individual effort alone was the best. Seventy-seven percent of the class thought that the individual assignment part of the project helped them to learn more about dosage form design by reading and criticizing the reports of all groups in the class, and 76% said that the additional learning they gained from this project was worth the additional workload placed on them. Finally, 68% of the class thought that the groups performed well even without peer evaluation.

In addition, two quizzes were designed to test the students' in-depth understanding of the tablet, ophthalmic, and transdermal dosage forms, somewhat beyond what is typically provided in a pharmaceutics textbook or covered in class. One test was given following the completion of the cooperative group effort, and the other was given at the completion of the individual effort fol-

lowing posting of all group reports on the Web. An attempt was made to design both quizzes at the same level of difficulty, although about half the questions were different. Thus, an adequate control group was lacking. However, there was a concern that having all the same questions might also invalidate meaningful comparisons, as the students could have discussed or researched the questions on Quiz I after it was administered.

The class average was 51% on the first quiz and 87% on the second quiz. The difference is statistically significant as determined by single-factor ANOVA ($p < 0.001$). While it is not possible to directly link the perceptions about the course and the improved performance on Quiz 2 to the teaching method employed, there is some evidence that this strategy might have some benefit. Additionally, this seems to be an innovative and effective way to engage students in learning and to identify areas in which they are struggling (by reviewing their critiques of the reports), which can then be addressed by the instructor.

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APPENDIX

**Assessment of Dosage Form Development Project**

This is a survey to get your feedback on the group project.

***Assessment of "Cooperative Group Effort"***

1. Do you feel:

   a. Peer evaluation would have helped each group member to take more responsibility and should have been included.
   b. The groups performed well even without peer evaluation and this was a better format for group activities.

***Assessment of Activity Following "Cooperative Group Effort"***

2. Did you feel this activity (individual assignment) helped you to learn more about dosage form design by reading and criticizing the reports of all groups in the class?

   a. Yes
   b. No

***Overall Evaluation***

3. Do you feel the group projects are useful to enhance learning in addition to didactic lectures?

   a. Yes
   b. No

4. Do you think the additional learning you gained from this project was worth the additional workload placed on you?

   a. Yes
   b. No

5. In order to enhance learning, which of the following do you think are most effective?

   a. Group projects alone
   b. Individual effort alone
   c. Group project followed by individual effort